ON THE RECOVERY OF SURFACE LOADS FROM A COMBINATION OF SATELLITE GRAVIMETRY AND GEOMETRIC POSITIONING

Juergen Kusche

DEOS, Delft University of Technology

Monitoring large-scale mass flux (ocean, hydrology) occurring at or near the Earth's surface is the primary aim of the Gravity Recovery and Climate Experiment (GRACE) mission. Time-variable gravity data from GRACE can be uniquely inverted to ocean mass and continental hydrology, since mass transfers located at the surface are much larger on shorter (several days - interannual) time scales than those taking place within the deeper Earth, and because one can remove the contribution of atmospheric masses from air pressure data. Yet it has been proposed by Blewitt et al (2001) and Wu et al (2002) that at larger scales this may be achieved independently by measuring and inverting the elastic loading associated with edistributing masses, e. g. with the global network of the International GNSS Service (IGS). This is particularly interesting as long as GRACE monthly gravity solutions not yet match the targeted baseline accuracies at the lower spherical harmonics degrees, because GRACE does not deliver degree-1 coefficients, and because we have global GPS time series dating much longer back in time than GRACE and will have them continuing after the end of GRACE's lifetime.

Finding mass flux solutions consistent with both data sets is an interesting and challenging inverse problem, which has been posed in Kusche and Schrama (2005). GRACE provides time-series of spherical harmonic coefficients of the Earth's changing gravity field, with limited spectral resolution and noise level increasing with harmonic degree. GPS provides time series of 3D-displacements for a few hundred stations in a rather heterogeneous (scattered) network configuration, which contain the full (non-bandlimited) spectrum. Moreover, the forward operator - we use Farrell's (1972) spectral load Love number solution to the boundary value problem of elastostatics - exhibits quickly dropping singular values. Also at the other end of the spectrum care has to be exercised: degree-1 Love numbers have to be chosen consistently with the underlying concept of reference frame. Degree-1 deformation can be - if 3D-displacement data are used - separated from the effect of a pure geometrical transformation and therefore be used to infer the geocenter position even if the GPS data is affected by residual translations and rotations.

A direct comparison of the techniques, although it reveals some systematic differences that may be attributed to geographically correlated errors in the GPS system, encouraged us to apply the spectral combination. I will discuss numerical results and compare these to other independent solutions and models.